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ABSTRACT

This competency-based curriculum guide is a handbook for the development of welding trade programs. Based on a survey of Alaskan welding employers, it includes all competencies a student should acquire in such a welding program. The handbook stresses the importance of understanding the principles associated with the various elements of welding. Units begin with definitions of terms and principles so that students will have conceptual frameworks upon which they may develop a complete perspective for working in the field. The handbook is organized in these seven sections: (1) the concept of competency-based curriculum and the role of vocational educators in curriculum planning, implementation, and evaluation; (2) the scope and sequence of welding competencies; (3) course descriptions to assist school districts in developing their vocational programs; (4) competencies and tasks for the following subjects--welding safety and health, tools and equipment, blueprints and layouts, welding metallurgy, employability skills, oxyacetylene welding and cutting, shielded metal arc and air carbon arc welding, gas metal and flux core arc welding, gas tungsten arc welding, special welding processes, and fabrication, repair, and rigging skills; (5) curriculum analysis matrices to be used to determine competencies for specific welding courses; (6) a sample skills card for evaluating and recording student progress; and (7) information on resources and specific materials available in Alaska and the rest of the nation, along with a suggested tools list and minimum tools and equipment needed. (KC)

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Welding Curriculum

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Welding
Curriculum

State of Alaska
Steve Cowper, Governor

Developed by the:
Alaska Department of Education
Office of Adult and Vocational Education

William G. Demmert, Commissioner

Karen Ryals, Director,
Office of Adult and Vocational Education

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Table of Contents

Page No.

Foreword ——— i

Acknowledgements ——— iii

I. Introduction to Competency-Based Curriculum

Competency Based Curriculum ——— 1
Curriculum Delivery Systems ——— 2
Role of Instructor in Curriculum Planning, Implementation, and Evaluation ——— 2

II. Program Development ——— 7

Scope of Welding ——— 8

III. Course Descriptions ——— 11

IV. Competencies and Tasks

Core Welding Competencies
Welding Safety and Health ——— 15
Tools and Equipment ——— 19
Blueprints and Layout/Specifications and Code ——— 21
Welding Metallurgy ——— 23
Employability Skills ——— 25

Applied or Specialized Welding Competencies
Oxyacetylene Welding and Cutting (OAW & OFC-A) ——— 31
Shielded Metal Arc Welding (SMAW) and Air Carbon Arc Welding (AAC) ——— 33
Gas Metal and Flux Core Arc Welding (GMAW & FCAW) ——— 35
Gas Tungsten Arc Welding (GTAW) ——— 37
Special Welding Processes/Techniques ——— 39
Fabrication and Repair and Rigging Skills ——— 41

V. Curriculum Analysis Matrices ——— 45

VI. Sample Skills Card ——— 53

VII. Suggested Resources ——— 57

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Foreword

This competency-based curriculum is designed to be a handbook for the welding trade. It includes all competencies a student will acquire in a welding program. Since the standards used to judge weld quality are national standards, articulation with post secondary programs could be arranged through a testing process and college credit could be obtained. The welding program detailed in this curriculum may also help students in entering an apprenticeship program. Welding is a trade and a tool–one of the many tools of industry.

Development of this handbook began with a survey of Alaskan welding employers. Their priorities regarding the skills and knowledge students need to acquire to survive and thrive in the industry form the basis of this handbook. For example, industry's emphasis on the importance of communication and personal skills is reflected in the employability skills unit.

The handbook stresses the importance of understanding the principles associated with the various elements of welding. Units begin with definition of terms and principles so that students will have conceptual frameworks to which they may add the details of various techniques. The seven units, divided into competencies and tasks, are fundamental to welding. The competencies and tasks are presented so that instructors have the prerogative to determine which aspects they want to teach in basic, intermediate, and advanced level courses.

The following example demonstrates how this curriculum may be used and applied. Bill Johnson has been a vocational teacher at a rural Alaskan site for two years and he's very interested in initiating a program in welding. He performs a needs assessment of his community and determines that a person who is able to weld aluminum skiffs would have a good chance of attaining employment. He also discovers that such welding skills would have some direct application for personal uses in subsistence and other self-sufficiency activities. He looks at the *Welding Scope and Sequence* to choose the processes which he will need to initiate a welding course to attain skill in aluminum welding. Those areas would include *Welding Safety and Health, Tools and Equipment, Employability Skills, GMAW & FCAW, GTAW and some Special Welding Processes and/or Welding Metallurgy and/or Fabrication and Repair and Rigging Skills.* He then turns to the *Curriculum Analysis Matrices* and names his course ("Welding I") in the vertical column at the top of the page and reviews the list of competencies checking off those competencies he will teach in the course. It's that simple. Then he writes a course description (based on the samples in the *Course Descriptions*).

Bill refers to the body of this book for the tasks involved in teaching those competencies. The competencies and tasks which compose the course depend on the location, the expertise of the instructor, time constraints, equipment available, and the project(s) to be undertaken, all of which may relate to the entry-level jobs available in the community. Bill reorders the competencies to fit his program. He uses the cross-reference guides from the matrix to approach school administration about obtaining academic credit in given areas for the class. In the *Suggested Resources* section he finds a *Tools List* and a list of Suggested *Minimum Tools and Equipment* needed for the welding program. Bill writes for materials from several manufacturers and publishers. Bill uses the *sample skills card*, provided in the curriculum, as a model for developing other skills cards for evaluation of student's skills.

If Bill Johnson's targeted skills involved stainless piping, he would of course pick other units, competencies and tasks.

A welding program focusing on basic welding skills without a specific skill area emphasis, will require a minimum of a two year course sequence to provide job training skills and preparation for post secondary education.

The handbook is organized into seven sections:

Section I introduces the concept of competency-based curriculum. The role of vocational educators in curriculum planning, implementation, and evaluation is also included.

Section II provides the scope and sequence of welding competencies.

Section III contains course descriptions to assist school districts in developing their vocational programs.

Section IV presents the curriculum including the competencies and tasks for welding instruction.

Section V provides curriculum analysis matrices to be used to determine competencies to be included in specific welding courses.

Section VI contains a sample skills card for evaluating and recording student progress.

Section VII lists information on resources and specific materials available in Alaska and the rest of the nation. **A suggested tools list and minimum tools and equipment needed for a welding program is included.**

It is recommended that all students participate in career awareness and exploration experiences to help them understand the connection between school and work and make career plans.

Acknowledgements

This handbook reflects the competencies needed for entry-level employment as identified by Alaskan welding professionals. Thanks and recognition go to the following technical committee members for their assistance and cooperation:

Alaska Welding Technologies, Ketchikan
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Fast Ed's Welding, Juneau
North Coast Welding, Dillingham
Peninsula Institute of Welding Technology, Kenai
Phil's Welding, Juneau
Smokeeter Sales and Service, Anchorage
Tech Welding Service, Anchorage

A task force of welding educators helped to define the units, competencies and tasks, course descriptions, academic cross-credit, and scope and sequence for the curriculum. The task force which met to finalize this handbook deserves a great deal of credit for their hard work and valuable input:

- **Gerald Park**, Instructor, University of Alaska Anchorage
- **Dwight Perkins**, Business Manager, Plumbers and Pipefitters Union Local 262, Juneau

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- **Michael Anderson**, Program Manager, Office of Adult and Vocational Education, Alaska Department of Education, Juneau
- **Dick Banta**, Safety and Training Unit, ARCO Alaska , Anchorage
- **Dick Larson**, Welding Instructor, University of Alaska-Southeast, Juneau
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- **Sam Rogers**, Vocational Instructor, Northwest College, Nome
- **Walter Ward**, Vocational Instructor, Soldotna High School, Soldotna

Special appreciation is expressed to **Richard Steele** and **Carin Smolin** who coordinated the preparation and completion of this handbook, and to **Mark Hanson**, Associate Director of the South East Regional Resource Center, who administered this project.

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Thanks also go to the National Network for Curriculum Coordination in Vocational and Technical Education (NNCCVTE) and participating states for providing resource materials which improved the quality of this handbook and saved months of work.

Finally, **Verdell Jackson**, Curriculum Specialist for the Office of Adult and Vocational Education, must be recognized for designing the curriculum development process and for participating in every step of the handbook's development ensuring that it is a model Alaskan curriculum of the highest quality.

Karen Ryals
Director
Office of Adult and Vocational Education
Alaska Department of Education
November 1989

Introduction to Competency-Based Curriculum

Competency-Based Curriculum

Vocational education should be directed toward the skills, knowledge, and attitudes needed for successful employment. Welding educators need to continually update their curriculum in order to prepare students for competition in the job market.

An effective method for delivering vocational education is through a competency-based curriculum. This curriculum is based on an analysis of the key occupations in welding. Once a competency-based curriculum is set in place, student performance must be measured on levels of proficiency in those competencies. Thus, the critical features of competency-based education are:

1) validating competencies to be included in the curriculum; and
2) evaluation of student competency levels.

This curriculum handbook sets direction for local curriculum developers. It provides a framework for developing courses of study and lesson plans in local schools.

Curriculum Based On Competencies

Competence refers to the adequate performance of a task. The task may be evaluated according to the performance or process, the service, or both.

Competency-Based Vocational Education consists of programs that derive their content from the tasks performed in each occupation/job and assess student performance on the basis of preset performance standards.

Learning materials define the competencies the student is to master, the criteria by which the student will be evaluated, and the conditions under which the evaluation will occur.

Competency-based instruction places emphasis on the ability to do, as well as on learning how and why. Student performance and knowledge are individually evaluated against the stated criteria, rather than against group norms.

The competency process utilizes a checklist of attitudes, knowledge, and skills that are commonly needed by entry-level employees in welding occupations. In developing this curriculum handbook, a cross-section of welding professionals were asked to respond to a survey on the basis of needs within their own establishments. The survey results were summarized to determine which attitudes, knowledge, and skills were important to firms in Alaska.

Student Performance Assessment

A curriculum becomes competency-based when students are assessed on the basis of their competence. A sample skills card is provided in this guide for teachers who wish to use them in assessing the competency levels of their students. The card has four levels of proficiency which allow continued development of skills. The card can be used to monitor students' progress as they move between welding classes, between teachers and grade levels, and between school and work. The completed skills card is an important part of a placement portfolio when students begin their job search.

Curriculum Delivery Systems

Vocational Student Leadership Organizations

Some of the competencies in this curriculum guide cannot be fully met in traditional classroom and lab settings. The Vocational Industrial Clubs of America (VICA) is a delivery system which can be integrated into the regular school program. Human relations skills as well as job skills will be enhanced by student participation in VICA. VICA activities should complement instruction in the welding classroom and lab. They should be integrated as a curriculum delivery system and not allowed to become an extracurricular activity.

Cooperative Work Experience

Some of the competencies identified in this guide cannot be fully developed at a school site. A work station in the community offers realistic experiences in fulfilling the program goals in career development and human relations. Cooperative Work Experience offers an excellent vehicle for the delivery of instruction. With well developed training plans, teachers and employers can cooperate to prepare students for employment. Cooperative Work Experience extends the instructional program beyond the availability of equipment and instructor time at the local school. Teachers and employers must maintain regular communications to assure that students are receiving a high quality experience.

The Rural Student Vocational Program (RSVP) provides a two week full-time work experience for students from rural areas where job stations are limited or non-existent.

Job Training Partnership Act (JTPA) programs provide on-the-job experience to disadvantaged youth in both urban and rural areas.

Role of Instructor in Curriculum Planning, Implementation, and Evaluation

The vocational instructor fulfills many roles which include the following responsibilities:

- Prepares a written vocational program plan.
- Develops and maintains a written program philosophy with objectives that support the philosophy.
- Maintains a written list of competencies identified as needed for the program area.
- Devises and maintains a classroom management system for implementing the curriculum materials provided for the program area.
- Evaluates the curriculum content periodically to determine curriculum changes and updates. This includes the involvement of the students (present and former), advisory committee members, and other personnel.
- Selects units of instruction and lesson plans based on the competencies of the occupation.
- Provides appropriate instructional materials, supplies, and equipment for the students to use.
- Provides school guidance counselor with information and updates regarding implementation of the specific curriculum.

- Reviews the instructional materials to assure that they are free from sex bias and sex role stereotyping.
- Works with an advisory committee.
- Assists and/or serves as an advisor to the appropriate student organization related to the vocational program area.
- Plans and arranges an appropriate classroom learning environment. This involves assisting students of different abilities to work at their own pace and in cases where remedial instruction is needed, securing additional help for those students.
- Reinforces basic skills of reading, communication (written & oral) and computation through vocational education experiences.
- Helps determine what objective(s) should be established for handicapped students as a part of the individual educational plan (IEP) development.
- Uses a grading procedure that is made available to all students at the beginning of their training.
- Sets an example for grooming and dress that is generally found in the occupational area in business or industry to enable students to establish appropriate standards.

Benefits of the Competency-Based Curriculum

Competency-based vocational education offers several benefits to students:

1. The competencies/tasks are directed to the student and provide measurable criteria for determining when the student has acquired the necessary knowledge and skills.
2. Students receive realistic training for the job. They become competent in tasks that are relevant to the occupation.
3. Students know what is expected of them throughout the course. The competencies are made available to them at the onset. They know what they will be doing and how well it must be done.
4. Each student is individually responsible for completing each competency attempted in the curriculum.
5. The basic thrust of the competency-based program is to evaluate students according to their accomplishment of tasks as they work up to individual capability. Students are not compared with other students in their accomplishments because each is expected to work according to employment standards. Because of the various evaluation policies of different school systems, the ideal of not comparing students in determining grades is not always possible.

II
Program Development

Program Development

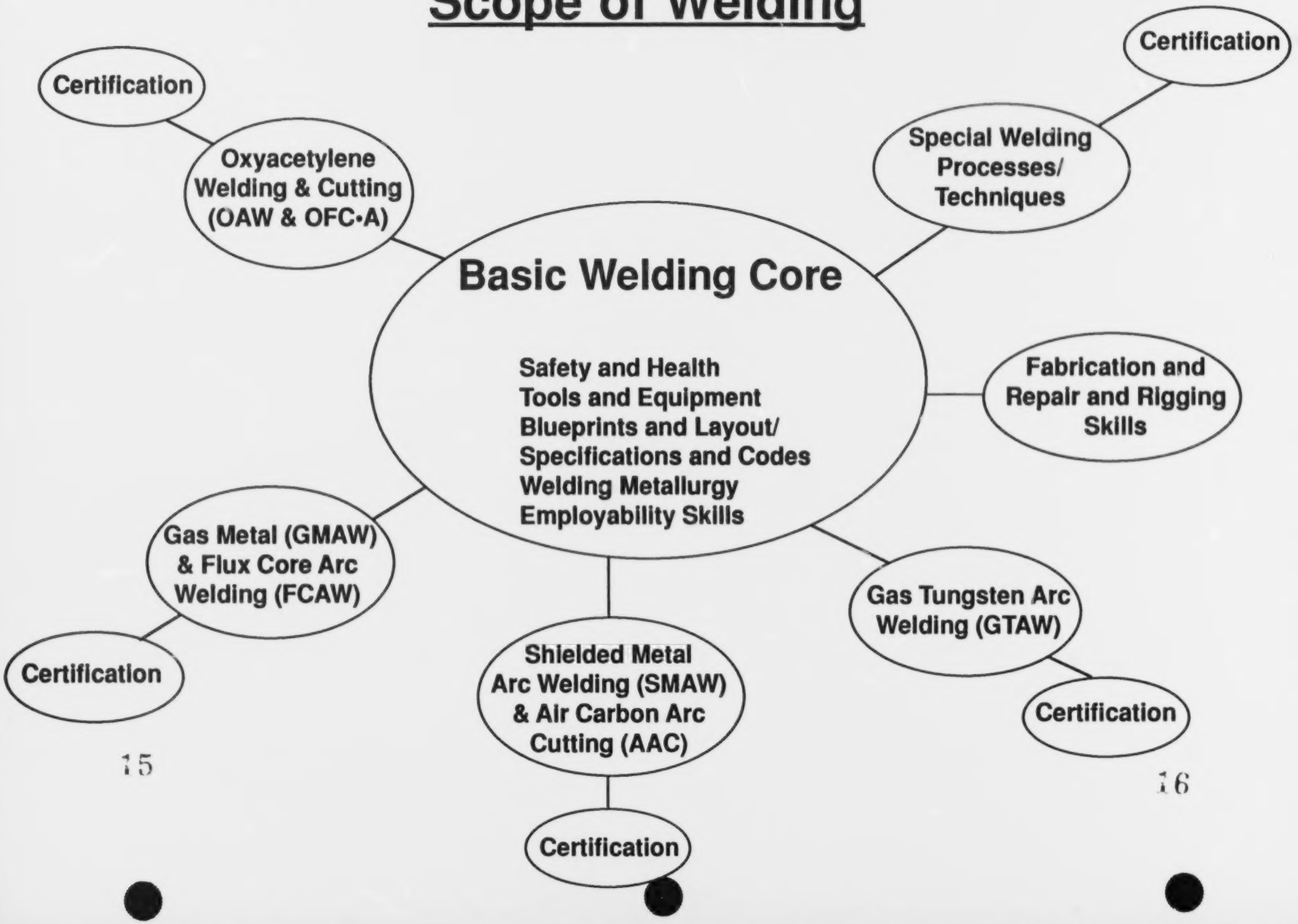
The format of this handbook was selected to aid administrators and teachers in concentrating on the skills needed for vocational training. It will assist in selecting the array of units and the delivery system which fit the school. This provides the flexibility of varying the course content to include the most valuable skills as appropriate for the scope and sequence. The primary importance is that students are able to secure foundation skills. Schools can vary their delivery systems to maximize student opportunities by:

1. Offering courses on alternate years or other planned sequences
2. Offering two or more courses in the same class
3. Providing individualized materials and instruction

A matrix is included in this guide for use in planning the courses to be offered and the content of each course.

The following chart shows the scope of welding competencies.

Scope of Welding



III
Course Descriptions

Course Descriptions

These brief course descriptions provide a conceptual framework for the design and implementation of a balanced program in welding. Teachers can use these descriptions to organize course offerings in welding education. Local schools will need to provide more definition regarding the content of their courses than is reflected in these general course descriptions.

Use the curriculum analysis matrices to help build your own courses, depending on your school, location, equipment, and training of the instructor.

Course: **Welding I**
Length: one semester
Grades: 9-12th grades

This course covers the basic operations of welding including safety and health, tools and equipment, blueprints and layout/specifications and codes, welding metallurgy, and employability skills. Setup and weld quality will be stressed. There isn't any prerequisite for this course.

Course: **Welding II**
Length: one semester
Grades: 10th-12th grades or post secondary
Prerequisite: Welding I

This course provides students with a review of welding techniques. They will learn the basics of one or more of the following: OAW, OFC•A, SMAW, AAC, GMAW, FCAW and GTAW. Students will complete advanced welds and metal cutting with concentration on skills needed in their communities. Students will utilize blueprint and layout skills. They will complete a fabrication or repair project or participate in Cooperative Education. The course will stress high standards of safety in the use and operation of welding equipment and processes.

Course: **Welding III**
Length: one semester
Grades: 11-12th grade or post secondary
Prerequisites: Welding I and II

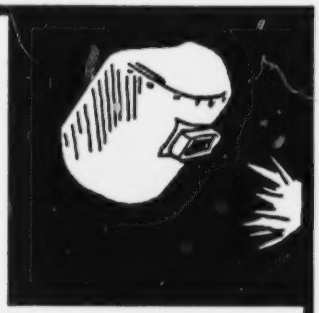
This course includes a review of all of the skills learned in Welding I and II. Students will learn advanced techniques of one or more of the following: OAW, OFC•A, SMAW, AAC, GMAW, FCAW, GTAW. Students will complete advanced welds and metal cutting with concentration on skills needed in their communities. Students will utilize blueprint and layout skills. Students will complete a fabrication or repair project or participate in Cooperative Education. Students will use rigging skills as necessary.

Course: **Welding IV**
Length: one semester
Grades: 11-12th grade or post secondary
Prerequisites: Welding I, II, and III

This course includes a review of all of the skills learned in Welding I, II, and III. The course includes the comprehensive study and application of blueprints and layout/specifications, codes, and fabrication, repair, and rigging skills. Students will complete advanced welds and metal cutting with concentration on skills needed in their communities. Opportunities will be provided for Cooperative Education programs. Students will prepare for certification in selected welding processes.

IV
Competencies and Tasks

Welding Safety and Health



(A) Indicates advanced competency or task

Competency: **Maintain a clean and safe shop**

Tasks:
Perform assigned shop cleanup duties
Keep floors and workbenches clean and neat
Wipe oil and grease spots immediately
Store materials, tools, and supplies in proper places
Dispose of combustible materials
Store oily rags in self-closing metal containers
Place scrap materials in proper containers
Clean and replace tools to storage locations
Keep aisles, traffic areas, and exits free of materials and other debris

Competency: **Use general safety procedures**

Tasks:
Follow safety rules for:
a. preventing fires
b. using hand tools
c. operating equipment
d. flammable metals and gases
e. avoiding electric shock
f. handling containers
g. toxic gases or displacement of breathing air

Identify ventilation procedures for the work area
Identify fire hazards in the shop
Identify the three components of the fire triangle
Demonstrate the handling and safe storage of gases
Differentiate among types and flammability of various gases in the shop
Follow all rules for handling gas cylinders safely
Identify different types and uses of fire extinguishers and other fire prevention devices
Follow safe procedures in regards to fire prevention at all times
Identify safety procedures around radiation and other hazardous materials on the job site
Wear protective clothing and devices such as:
a. safety glasses
b. face shield
c. welding helmets/goggles
d. hand shields
e. ear protection
f. jackets
g. gloves
h. boots
i. hair net
j. fire-resistant apron

Make sure clothing is free from oil and grease
Identify safety procedures for different types of welding
Identify proper procedures when moving or lifting heavy objects
(A) Identify air cleaners for welding applications such as:
a. direct capture air cleaners
b. free hung air cleaners

Competency: **Apply first aid skills**

Tasks:
Demonstrate first aid for victims of electrical shock
Demonstrate first aid for common welding injuries, especially burns
Explain ways to recognize shock
Demonstrate the steps in treating shock
Use first aid for eye injury
Follow other general guidelines for first aid emergencies
Complete a student safety pledge
(A) Demonstrate the steps used in controlling bleeding

Competency: **Use tools safely**

Tasks:
Keep all tools sharp, clean, and in safe working order
Demonstrate use of tools in prescribed manner including:
a. using proper tool for task
b. clamping projects securely before drilling or power grinding
c. using correct speed for power tools and drill bits when working with metal
d. using properly sharpened tools and drill bits
e. keeping all guards and safety devices in place and adjusted properly
f. turning off all power before leaving a machine tool
Report faulty shop tools and equipment

Competency: **Follow electrical safety procedures**

Tasks:
Explain rules and safety procedures for electric welding
Label circuit breakers
Ground electrical equipment, explaining how and why
Use flexible extension cords and drop lights
Identify electrical hazards
Identify locations of all electrical equipment and power sources
Never operate ungrounded equipment
Never arc weld or operate electrically powered equipment while standing on wet or damp floors

Competency: **Use safe welding procedures**

Tasks:
Wear safety glasses and clothing
Never weld, cut, or grind near flammable or explosive materials
Keep oil away from gas cylinders, regulators, connections and hoses
Keep electrode holder away fromwelding machine or gas cylinder
Do not cut or weld directly on concrete
Properly purge barrels, drums or other containers
Cut into barrels, drums, or any containers that have been purged
Never ground electrical equipment to a building member or a piece of equipment attached to or part of a building
Never engage in horseplay of any kind
Clean work carefully
Secure tanks
Place work in jigs or other holding fixtures
Do not weld near batteries
Protect wood or combustible materials from direct heat

Do not open an acetylene cylinder valve near open flames or other welding and cutting and brazing
Shut off oxygen and acetylene at the cylinder valves when leaving the area

(A) Competency: **Follow OSHA and AWS guidelines**

Tasks:

Explain purpose of Occupational Safety and Health Act (OSHA)
Identify worker rights under OSHA
Explain how to resolve hazardous and OSHA violations
Identify employee rights according to OSHA
Maintain records of work-related injuries
Explain how to report worker compensation claims
Identify the role of the American Welding Society (AWS)
Identify AWS guidelines and publications
Interpret Material Safety Data Sheets (MSDS's)
Use color-coded signs to warn of danger

Tools and Equipment

Competency: **Use welding hand tools**

Tasks: Demonstrate the use of welding hand tools such as:

a. alignment tools
b. bevel square
c. chisels, punches, and pry bars
d. combination square
e. dies and punches
f. driving and chipping tools
g. files
h. fillet weld gauge
i. framing square
j. gauges
k. jacks
l. jig
m. manual cutting and shaping tools
n. measuring tools
o. pliers
p. positioners
q. pulling and lifting tools
r. semi-precision measuring tools
s. turning tools and wrenches
t. wire brushes
u. work holding devices

Follow basic rules for safe use and maintenance of hand tools
Measure parts with semi-precision measuring tools
Inspect parts with precision measuring tools
Maintain and store tools

Competency: **Use welding shop power tools**

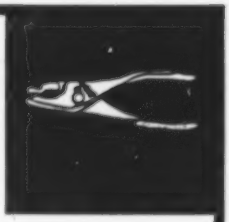
Tasks: Demonstrate welding power tools such as:

a. air chisel
b. beveling machine
c. electric hammers
d. hand bending brakes
e. hand grinders
f. hydraulic shear
g. mechanical shear
h. metal-cutting band saws
i. non-destructive testing
j. pedestal grinder
k. pneumatic shear
l. portable electric hand tools
m. portable screen
n. power press brakes
o. power squaring shears
p. power wire brush
q. preheating and annealing equipment
r. rod oven
s. sandblasting equipment
t. shears and nibblers
u. spot welder
v. turning rolls
w. universal bender
x. welding positioners
y. wire feed mechanisms

Follow basic rules for safe use and maintenance of welding and shop equipment including:

a. cleaning
b. blowing dust out of welding machine with clean, dry air
c. checking compressed gas systems for leaks
d. lubricating rotating and moving components
e. ventilating stored equipment

Competency: **Utilize measurements and measuring devices**



Tasks:

Read common measurement tools such as:

a. calipers
b. micrometers
c. protractors
d. rulers
e. squares
f. tape measures
g. vernier gauge

Identify decimal and metric equivalents

Make accurate measurements to 1 mm (or 1/32 of an inch)

Accurately measure angles to the nearest degree

Measure:

a. distance with 8 mm and 4 mm (or 1/4" and 1/8") graduations
b. distance with 4 mm (or 1/8") graduations
c. distance with 2 mm (or 1/16") graduations
d. dimensions of given objects with a rule
e. given lines and objects with a rule

Draw lines and objects to given specifications using a rule

Find the mid-point of given lines and figures

Adjust a bevel square to a 45° angle using a framing square, a combination square, and a protractor

Use a combination square to form 90° and 45° angles and to draw parallel lines on selected metal stock

Determine if an object is square

24

Blueprints and Layout/ Specifications and Codes

(A) Indicates advanced competency or task

Competency: **Use welding symbols and codes**

Tasks:

Identify welding symbols including:
- a. arrow, reference line, and tail
- b. AWS standard welding symbol chart
- c. location significance
- d. process abbreviations
- e. basic joints
- f. applications of symbols and codes
- g. designation of extent of welding
- h. combined welds
- i. groove preparation
- j. brazing symbols
- k. other basic weld symbols
- l. other supplementary symbols
- m. non-destructive testing symbols

Identify welding codes including:
- a. American Welding Society (AWS) codes
- b. American Society of Mechanical Engineers (ASME) codes
- c. American Petroleum Institute (API) codes

Competency: **Understand welding blueprints**

Tasks:

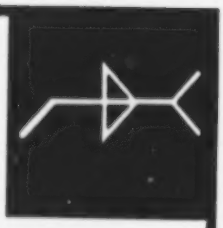
Identify the following blueprint nomenclatures:
- a. lines
- b. views
- c. dimensions
- d. tolerances
- e. materials
- f. symbols
- g. types of drawings
- h. planed-lining sections

Interpret welding blueprints
Use mathematics related to print reading

Competency: **Apply basic math**

Tasks:

Identify basic mathematical terms and their definitions
Identify advantages of decimal equivalent and conversion charts
Explain uses for fractions and decimals
Explain percent and its uses
Identify units of measure found on rules
Follow the steps for reading a rule
Find the mid-point of a given distance
Use the formulas for perimeters
Identify basic geometric figures



Size commonly used steel stock
Add, subtract, multiply, and divide fractions
Add, subtract, multiply, and divide decimal equivalents
Write fractions as decimals and percents
Write percents as fractions and decimals
Write decimals as fractions and percents
Make conversions with the decimal equivalent and inches to decimal conversion charts
Use the English-Metric Conversion Chart
Calculate the following:

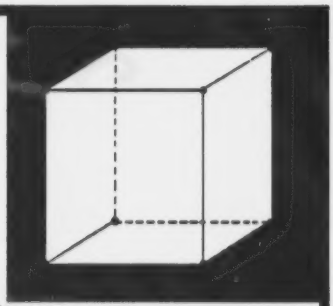
a. perimeters of given rectangles
b. perimeters of given squares
c. perimeters of given triangles
d. areas of given parallelograms
e. areas of given rectangles
f. areas of given squares
g. areas of given triangles
h. areas of given rhombuses
i. areas of given trapezoids
j. circumferences of given circles
k. areas of given circles

Competency: **Use drawings**

Tasks:

Identify structural shapes and symbols
Make three-view sketch
Make an isometric sketch
Make template from blueprint
Fabricate a part from a drawing according to welding procedures
Read and follow metalworking specifications and directions
Draw and follow a welding project plan including dimensions
(A) Interpret pipe and instrument drawings

Welding Metallurgy



(A) Indicates advanced competency or task

Competency: **Understand properties of metals**

Tasks:

Explain terms and principles associated with metallurgy such as:
- a. extractive metallurgy
- b. physical metallurgy
- c. process metallurgy

Identify ferrous metals, non-ferrous metals, and alloys and describe their characteristics
Clean, test, and classify ferrous metals
Clean, test, and classify non-ferrous metals
Trace the formation of a given metal product from ore extraction to product sale, including metals processing
Identify samples of common metals and relate their use in welding
Explain heat flow and its application to bending and forming metals
Identify respective welding materials compatibility
Identify appropriate metals for selected projects
Identify possible hazardous metals which a welder might encounter
Describe the process of heat treatment with plain carbon steels
(A) Identify properties which create the need for steel classifications and interpret data from resource information

(A) Competency: **Identify the metallurgy of a weld bead**

Tasks:

Explain different welding processes–gas or arc
Explain:
- a. grain structure
- b. cooling rates
- c. fusion surfaces
- d. dilution
- e. hydrogen embrittlement

Explain the importance of proper weld inspection
(A) Explain grain structure, cooling rates, fusion surfaces, dilution, and hydrogen embrittlement in depth for different metals

Employability Skills

Competency: **Make career choices**

Tasks:

Conduct a self-assessment:
- a. assess values in relation to work
- b. recognize skills and aptitudes
- c. assess employment history and experience
- d. describe obstacles to employment
- e. use Alaska Career Information System and other career counseling systems and publications (i.e. ASVAB)

Identify career clusters:
- a. list specific jobs and duties within clusters
- b. describe apprenticeship/training programs
- c. describe advanced training opportunities

Use labor market information:
- a. describe the current local labor market
- b. identify growth/demand occupations
- c. relate career choices to local labor market

Select a career goal:
- a. list how skills could be used in other jobs (including limitations), such as:
  1. agriculture worker
  2. aircraft (A&P) mechanic
  3. auto body repairer
  4. automotive mechanic
  5. building and grounds maintenance workers
  6. carpenter
  7. electrician
  8. heavy equipment mechanic
  9. millwright
  10. miner
  11. other construction-related jobs
  12. plumber
  13. shipwright
- b. develop specific steps to reach goal

Competency: **Evaluate jobs in the welding industry**

Tasks:

Identify educational and occupational opportunities such as:
- a. adult, postsecondary vocational training
- b. special grants from industry
- c. federal, state, and local funding

Locate resources for finding employment

Confer with prospective employers

Explain the work of a(an):
- a. arc cutter
- b. arc welder
- c. boat builder
- d. brazer assembler
- e. combination welder
- f. gas welder
- g. hand thermal cutter
- h. inspector
- k. specialist welder
- l. tack welder
- m. welder
- n. welder fitter
- o. welder helper
- p. welding engineer
- q. welding instructor
- r. welding operator

i. pipe fitter
j. production line welder
s. welding supervisor
t. welding technician

Identify steps for obtaining welding certification
Identify steps for apprenticeship
Explain the role of union membership

Competency: **Prepare a resume and job application**

Tasks:
Obtain a social security number
List the following in the resumé:
a. job objective
b. education
c. past and present work experience
d. hobbies and interests
e. community activities or memberships
f. in-school activities or memberships
g. awards, positions, or club offices
h. adult references, including addresses and phone numbers

Obtain extra copies of resume
Read job applications carefully
Follow instructions
Complete all items accurately
Write legibly
Verify references before listing them

Competency: **Write a cover letter**

Tasks:
Explain what a writing sample tells a potential employer
Explain when and how to write a cover letter
List the things the cover letter must include

Competency: **Interview for a job**

Tasks:
Contact an employer to schedule an interview
Prepare responses to questions asked in an interview
Use proper etiquette
Dress appropriately

Competency: **Follow up the interview**

Tasks:
Analyze the interview
Determine whether a follow-up letter or call is required
Write a thank-you note or make a follow-up call

Competency: **Dress appropriately on the job**

Tasks:
Identify proper attire for welding jobs
Be neat and clean

Competency: **Manage personal responsibilities related to employment**

Tasks:
Secure adequate transportation
Identify adequate child care alternatives
Secure appropriate child care
Use independent living skills
Develop a personal finance plan

Competency: **Maintain good health for effective job performance**

Tasks:
Exercise regularly
Eat properly
Get adequate rest
Explain the issue of smoking on the job
Refrain from drug abuse
Identify hazards of job-related infectious diseases and how to avoid them

Competency: **Understand employee rights and responsibilities**

Tasks:
Explain state labor laws relating to compensation
Complete complex tax forms
Describe:
a. minimum wage and types of exempt businesses
b. employee benefits, rights and responsibilities
c. labor contracts, grievance procedures and the role of unions
Review a sample personnel policy

Competency: **Attain work maturity**

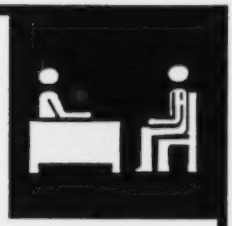
Tasks:
Describe the importance of openness to new situations
Demonstrate characteristics of the mature person:
a. self-acceptance
b. consideration and respect for others
c. self-control
d. positive thinking and attitudes
e. flexibility
f. initiative
g. punctuality
Maintain good work relationships
Differentiate between personal and job-related problems
Follow orderly and systematic work behavior
Be punctual

Competency: **Make effective decisions**

Tasks:
Explain the importance of having a method for analyzing and solving problems
Use the problem-solving process:
a. identify problems
b. obtain information
c. analyze problems
d. develop and analyze alternative solutions
e. choose a course of action
f. persevere through hardships
g. recognize and change otherwise unworkable solutions
List objectives for completion of a task
Arrange objectives in a sequence
Establish timeline for completing objectives

Competency: **Demonstrate initiative and productivity**

Tasks:
Organize time effectively
Set priorities
Be responsible



Care about the quality of work
Complete assignments in an accurate and timely manner
Exhibit ability to handle pressures and tensions

Competency: **Be assertive**

Tasks:
Differentiate between assertive, aggressive, and passive behavior
Explain to whom to go for employee problems

Competency: **Be honest**

Tasks:
Define honesty and integrity
Relate employee integrity to overall company performance
Explain how to deal with theft and dishonesty

Competency: **Be reliable and dependable**

Tasks:
Maintain acceptable attendance records
Be on time
Give timely notice of interruptions to work schedule
Follow rules and regulations of work or training site
Follow directions

Competency: **Maintain good personal relations**

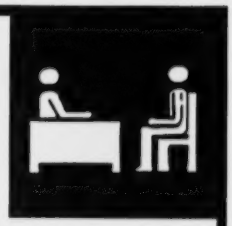
Tasks:
Accept chain of command
Use positive attitude with others
Accept supervision and criticism
Cooperate with others
Identify common on-the-job co-worker problems
Control emotions
Assume responsibility for own decisions and actions
Exhibit pride and loyalty

Competency: **Follow verbal and written directions**

Tasks:
Use listening skills
Ask for clarification
Review situations of poor communications
Read directions when assembling and repairing equipment

Competency: **Apply communication skills**

Tasks:
Read technical journals
Use technical vocabulary
Locate information in trade and consumer magazines and supply catalogs
Write work orders, parts orders and warranty reports
Locate and correct errors in spelling, grammar, and punctuation
Compose business letters
Transfer written messages to others verbally and in written form
Use good penmanship
Use proper telephone etiquette



Competency: **Deal effectively with customers**

Tasks:
Greet the customer
Identify the business on the telephone
Talk politely to customer
Obtain all necessary information from customer in writing
Relay customer complaints to employer

Competency: **Identify proper job termination procedures**

Tasks:
Write a letter of resignation
Make final settlements (in regards to retirement, physical injury, social security, severance pay, etc.)

Competency: **Use leadership skills**

Tasks:
Describe the Vocational Industrial Clubs of America (VICA) and how it teaches leadership skills:
a. participate in meetings according to rules of parliamentary procedure
b. function effectively on committees by accepting assigned responsibilities
c. plan and conduct effective group leadership activities
d. participate in society in a democratic way
e. be punctual and dependable
f. follow rules, standards and policies
g. work cooperatively with others

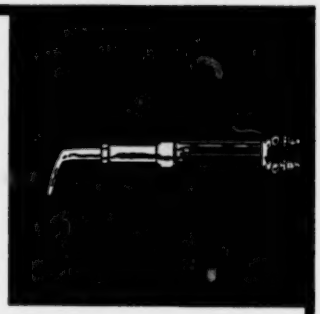
Explain importance of self-esteem
Practice eye contact
Use a firm handshake when appropriate
Use presentation skills
Use communication skills
Participate in leadership activities

Competency: **Evaluate personal traits in relationship to entrepreneurship**

Tasks:
Explain terms and principles associated with entrepreneurship
Describe the role of self-employment in the free enterprise system
Identify types of business organizations including:
a. sole proprietorship
b. limited partnership
c. partnership
d. corporation

Identify personal traits necessary for self-employment
Identify risks and rewards of starting a new business
Identify the role small businesses have played in job creation and new products and services
Identify the steps for establishing a business
Explain the importance of developing a business plan
Locate information and assistance on starting a small business

Oxyacetylene Welding and Cutting (OAW and OFC•A)



Competency: **Oxyacetylene weld**

Tasks:

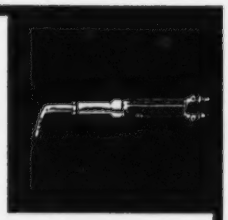
Identify terms and principles associated with OAW such as:
- a. flame types
- b. types of fuel gases
- c. oxygen and acetylene production
- d. combustion equation

Identify various types of gas welding equipment and processes
Explain properties of each gas
Follow safe operating procedures
Explain lighting and adjusting welding equipment using a:
- a. sparklighter
- b. torch tip wrench

Wear safety equipment such as:
- a. safety goggles
- b. thick gloves
- c. heavy shoes
- d. apron
- e. ear protection

Check gas welding equipment and make sure all gauges read zero before opening valves
Turn on oxyacetylene equipment including:
- a. opening acetylene cylinder valve slowly, making sure to stand to the side
- b. opening oxygen cylinder valve slowly
- c. setting oxygen pressure gauge
- d. turning acetylene needle valve
- e. lighting torch with sparklighter pointing torch downward or toward workbench
- f. bringing flame back to torch tip turning acetylene needle valve
- g. turning oxygen needle valve until flame become bright blue with bright feather-shaped flame inside
- h. adjusting oxygen needle valve until flame is neutral

Oxyacetylene weld, including:
- a. selecting the proper welding or brazing process for the work
- b. selecting proper size tips, filler rod, and flame
- c. identifying codes applicable to welding process at hand
- d. using flux materials properly
- e. adjusting the oxyacetylene regulators for the task at hand
- f. keeping a properly adjusted flame at the torch tip for the welding task at hand
- g. demonstrating brazing techniques
- h. following proper welding techniques for quality workmanship
- i. performing proper weld joints such as butt, overlap or T joints, using both portable and stationary equipment
- j. identifying common weld defects, stating their causes and explaining how to correct them
- k. completing visual inspection of finished weld
- l. (A) explaining properties of different types of metals as affected by gas welding



Turn off gas welding equipment, including:

a. closing oxygen by turning oxygen needle valve
b. closing acetylene gas by turning off acetylene needle valve
c. closing acetylene cylinder valve
d. closing oxygen cylinder valve
e. draining off excess oxygen or acetylene gas still in the hoses
f. holding up torch until pointers on both acetylene gauges return to zero
g. turning oxygen and acetylene regulator adjusting screws until loose
h. closing acetylene and oxygen needle valves
i. properly storing and maintaining oxyacetylene equipment
j. properly handling and storing filler metals

Competency: **Oxyacetylene cut (OFC•A)**

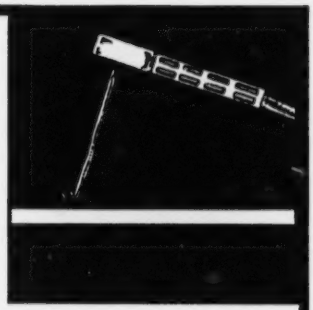
Tasks:

Explain terms and principles associated with (OFC•A) such as:

a. dross
b. kerf
c. oxidation
d. travel speed

Follow safe operating procedures at all times
Set up oxyacetylene cutting equipment minimizing any fire or injury hazards
Choose the proper cutting tip for the oxyacetylene cutting task at hand
Properly adjust the oxyacetylene cutting torch for efficient and effective metal cutting (attaining neutral flame)
Cut mild steel with oxyacetylene cutting torch
Make accurate straight or curved cuts
Complete visual inspection of finished cut
Store and maintain oxyacetylene equipment
Use track torch and cutting aids

Shielded Metal Arc Welding (SMAW) & Air Carbon Arc Cutting (AAC)



(A) Indicates advanced competency or task

Competency: **Identify principles of arc welding theory**

Tasks:

Explain the terms, principles and techniques associated with welding such as:
- a. AWS abbreviations
- b. welding polarity
- c. electrical principles
- d. travel speed
- e. work angle
- f. whipping

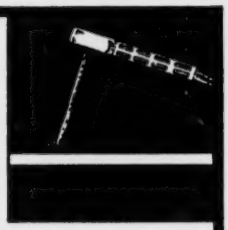
Describe how to determine the quality of a weld
Contrast the characteristics of AC and DC arc-welding units
Describe the consequence of insufficient and excessive amperage
Explain the standard electrode numbering system such as:
- a. 6011
- b. 6013
- c. 7014

Classify electrodes according to the standard system
Diagram the electronic and mechanical design of arc-welding equipment
Explain the function of arc-welding equipment components including the AC step-down transformer
Compute mathematical problems relating to welding
Explain how to determine the appropriate welding technique
Set up and utilize common electrodes
(A) Explain:
- a. line of flux
- b. induced voltage ratio
- c. voltage-amperage ratio

Competency: **Apply shielded metal arc welding skills (SMAW)**

Tasks:

Identify welding applications of SMAW
Follow safe and orderly procedures
Properly setup SMAW equipment
Identify codes applicable to welding process
Identify welding techniques for quality workmanship
SMAW weld, including:
- a. running beads with SMAW equipment:
  - 1. correct
  - 2. hot
  - 3. cold
  - 4. long arc
  - 5. fast
  - 6. slow
- b. applying surfacing skills
- c. arc-welding carbon steel
- d. arc welding heat and corrosion-resistant steel
- e. arc-welding cast iron and hard surface steel
- f. welding single pass and multiple pass lap joints
- g. welding outside corner joints
- h. welding multiple pass "tee" joints in all positions



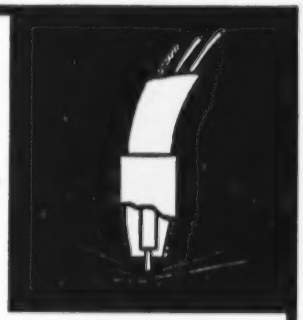
i. welding pre-qualified joints in all positions
j. identifying common weld defects, stating their causes and explaining how to correct them
k. completing visual inspection of finished weld
l. storing and maintaining SMAW equipment
m. handling and storing filler metals

Carbon Arc Cut (AAC), including:

a. cutting carbon steel using shielded metal arc cutting process
b. cutting carbon steel with air carbon arc process
c. cutting cast iron with air carbon arc process

(A) Complete welding qualifications related to SMAW

Gas Metal and Flux Core Arc Welding (GMAW and FCAW)



Competency: **Apply gas metal arc welding skills (GMAW)**

Tasks:

Explain terms and principles associated with GMAW such as:
- a. spray transfer
- b. globular transfer
- c. short arc transfer
- d. MIG

Identify equipment related to GMAW, including:
- a. power supply
- b. feeders
- c. guns
- d. consumable materials

Follow safe operating procedures
Set up GMAW equipment
Identify codes applicable to GMAW
Identify welding techniques for quality workmanship
GMAW weld, including:
- a. running beads
- b. welding carbon steel
- c. welding heat and corrosion-resistant steel
- d. welding cast iron and hard surface steel
- e. GMAW carbon steel joints
- f. running beads with GMAW equipment (MIG) in all positions
- g. welding mild steel joints
- h. welding stainless steel joints
- i. welding aluminum
- j. identifying common weld defects, stating their causes and correcting them
- k. completing visual inspection of finished weld
- l. storing and maintaining GMAW equipment
- m. handling and storing filler metals

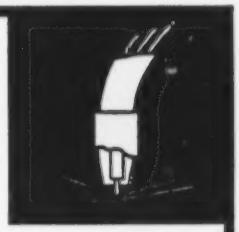
Competency: **Apply flux core arc welding skills (FCAW)**

Tasks:

Explain terms and principles associated with FCAW such as:
- a. self shielded
- b. gas shielded
- c. heat effected zone

Identify equipment related to FCAW including:
- a. power supply
- b. feeders
- c. guns
- d. consumable materials

Follow safe operating procedures
Properly set up FCAW equipment
Identify welding techniques for quality workmanship
FCAW weld, including:
- a. adjusting arc voltage to optimum condition for a given cored wire
- b. running beads in all positions using FCAW equipment
- c. FCAW carbon steel



d. FCAW heat and corrosion resistant steel
e. FCAW hard surface steel
f. welding carbon steel joints using FCAW
g. welding stainless steel joints with FCAW equipment
h. identifying common weld defects, stating their causes and explaining how to correct them
i. completing visual inspection of finished weld
j. storing and maintaining FCAW equipment
k. handling and storing filler metals

Gas Tungsten Arc Welding (GTAW)

Competency: **Apply gas tungsten arc welding skills (GTAW)**

Tasks:

Explain terms and principles associated with GTAW such as:
- a. high frequency
- b. 2% thoriated
- c. 1% thoriated
- d. zirconium
- e. balling

Identify equipment related to GTAW, including:
- a. power supply
- b. torches
- c. consumable materials

Follow safe operating procedures
Set up GTAW equipment (TIG)
Identify welding techniques for quality workmanship
Select appropriate filler rod for various welds and metals
Identify codes applicable to welding process
GTAW weld, including:
- a. running beads in all positions with GTAW equipment
- b. welding carbon steels
- c. welding aluminum and aluminum alloys
- d. welding heat and corrosion resistant steels
- e. welding copper or copper alloys
- f. welding chrome-moly steel
- g. welding magnesium alloys
- h. welding stainless steel joints with GTAW equipment
- i. identifying common weld defects, stating their causes and explaining how to correct them
- j. visually inspecting finished weld
- k. disassembling and cleaning TIG torch assembly
- l. storing and maintaining GTAW equipment
- m. handling and storing filler metals

Special Welding Processes/Techniques

(A) Indicates advanced competency or task

Competency: **Identify advanced welding techniques**

Tasks: Describe the following welding processes:

a. automatic arc welding
b. GTAW hot wire welding
c. plasma arc welding
d. laser welding
e. electroslag welding
f. electrogas welding
g. welding and bonding of plastics—characteristics, methods, inspection and testing
h. underwater welding

Competency: **Plasma cut**

Tasks: Use safety procedures
Set up and operate plasma cutting equipment
Lay out and:

a. cut straight lines on ferrous and nonferrous metals
b. angular-cut on ferrous and nonferrous metals
c. cut circles on ferrous and nonferrous metals
d. cut patterns on ferrous and nonferrous metals
e. cut beams and angle and channel iron on ferrous and nonferrous metals
f. cut and bevel pipe to a 30 degree to a 37 1/2 degree tolerance on ferrous and nonferrous metals
g. cut square and round solid stock on ferrous and nonferrous metals

(A) Lay out and stack-cut ferrous and nonferrous metals

(A) Competency: **Plasma arc weld**

Tasks: Use safety procedures
Set up and operate plasma arc welding equipment
Carry puddles without filler rod
Carry puddles with filler rod
Weld using stainless steel filler to match stainless steel material
Identify common plasma arc welding defects, state their causes and correct them
Visually inspect finished weld
Handle and store consumables
Store and maintain plasma arc welding equipment

(A) Competency: **Submerged arc weld (SAW)**

Tasks: Explain SAW process and equipment
Use safety procedures
Set up and operate SAW equipment
Identify common SAW defects, state their causes and correct them

Visually inspect finished weld
Store and maintain SAW equipment
Handle and store filler materials

(A) Competency: **Resistance weld (RSW)**

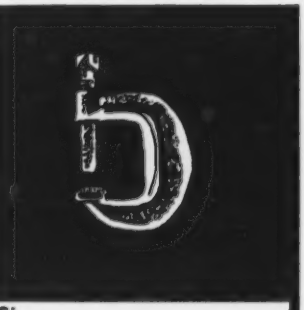
Tasks:
Explain RSW process and equipment
Use safety procedures
Set up and operate RSW equipment
Identify common RSW defects, state their causes and correct them
Visually inspect finished weld
Store and maintain RSW equipment

(A) Competency: **Weld pipe**

Tasks:
Weld pipe using the following techniques:
a. OAW
b. SMAW
c. GMAW
d. FCAW
e. GTAW

Identify codes applicable to welding process
Identify common pipe welding defects, state their causes, and correct them
Visually inspect finished weld
Disassemble and clean welding equipment
Store and maintain welding equipment

Fabrication, Repair, and Rigging Skills



(A) Indicates advanced competency or task

Competency: **Apply metalworking techniques**

Tasks:

Explain metalworking terms, principles, and techniques such as:
- a. drilling (including core drilling)
- b. boring
- c. countersinking
- d. heat treating
- e. riveting, etc.

Identify the relationship between speed and feed when drilling
Identify various methods for joining metal together
Interpret working drawings
Utilize techniques for bench metalwork including drilling, tapping, bending, and fitting
Employ a variety of standard techniques for metalwork such as layout, riveting, bending, forming, and finishing
Store and maintain all metalworking equipment
(A) Operate the metal lathe including turning between centers, turning with a chuck, turning a taper, knerling, and drilling
(A) Explain techniques for forging such as bending, shaping, fitting, and heat-treating
(A) Describe the casting process

Competency: **Heat, form, and bend**

Tasks:

Explain terms, principles, and techniques for heating, bending, and forming different metals including:
- a. annealing
- b. hardening
- c. tempering
- d. critical temperature

Apply the proper heat with an oxyacetylene torch to bend metal stock
Describe heat flow and its application to bending and forming metals with welding equipment
(A) Identify temperature of steel by color changes

Competency: **Use fabrication techniques**

Tasks:

Tack weld
Layout and scribe straight lines, circles and arcs on:
- a. plate and sheet steel
- b. angle iron
- c. channel iron
- d. beams
- e. pipe

Fit and fabricate structures using various materials including:
- a. channel iron
- b. beams
- c. pipe
- d. solid round stock

Use metal cutting and forming techniques

Competency: **Complete a welding repair or fabrication project**

Tasks:

Plan and lay out welding project, including:
- a. completing a working drawing or sketch
- b. materials list/cost estimate
- c. fixtures
- d. jigs
- e. project layout

Perform fabrication and welding processes
Inspect and repair project if necessary

Competency: **Use rigging skills**

Tasks:

Identify wire rope by its components
Explain how wire rope works mechanically
Explain safe factors/safe work load principles
Inspect for damage and when to discard
Identify proper storage methods
Follow the process for fibre rope, nylon, and chain
Demonstrate major configurations of slings
Demonstrate safe rigging principles on all slings
Calculate safe work loads for slings
Calculate the de-rating factors for sling angles
Demonstrate rigging hardware (sheaves, hooks, slings, shackles, eye bolts, turnbuckles, fittings, chain falls, come-alongs, overhead cranes, plate hooks), including:
- a. demonstrating proper use
- b. performing a basic inspection for safety purposes
- c. demonstrating proper hand signals
- d. calculating weight of object by adding actual weight of it's components
- e. estimating weight of object
- f. demonstrating how to move/turn objects in fabrication situations such as rotating, turning end for end, etc.
- g. locating center of gravity for odd-shaped objects
- h. describing use of tag lines and other safe rigging principles

Demonstrate overall rigging ability by planning an entire minor rigging job

V
Curriculum Analysis Matrices

Curriculum Analysis Matrices

Identified Competencies by Course Offerings

This competency checklist should be used by teachers in identifying competencies to be included in specific classes in welding education. This checklist is a curriculum analysis tool for use by teachers in assigning responsibilities for the competencies of a total welding program.

All courses taught in the welding program are identified in the columns at the top of the matrix. The individual competencies can be allocated to specific courses. One method for analyzing the competency list is to assign letters where the competency will be introduced (I), taught (T), or mastered (M). Curriculum sequences can be organized through this approach.

To assist welding teachers to reinforce basic skills instruction, competencies have been cross-referenced with the following academic areas:

Math (M)	Science (S)	Health (H)
Social Studies (SS)	Language Arts (LA)	

This will assist local school districts in awarding cross-credit (academic credit) for participation in vocational classes they deem appropriate.

The following checklists are also cross-referenced with the Job Training Partnership Act pre-employment competencies and student leadership competencies. The Job Training Partnership Act provides funds to train economically disadvantaged youth to enter and succeed in employment. Each Private Industry Council responsible for administering these funds adopted youth pre-employment competencies as one of the measures for positive termination for program participants. The other measures are attained through unsubsidized employment, or through another training program.

The following categories of work-related knowledge must be evaluated and measured in the course of a participant's enrollment in a JTPA program:

1. Pre-Employment Competencies, which require the participant to demonstrate the skills and knowledge necessary to identify career objectives, seek and obtain employment and understand job performance.

2. Work Maturity Competencies, which require the participant to demonstrate the ability to apply skills in a training position.

3. Educational Skills Competencies, which require the participant to demonstrate basic computation and communication skills necessary to enter the labor market.

4. Occupational Skills Competencies, which require the participant demonstrate proficiency in those skills necessary to maintain employment in a specific occupation or occupational cluster.

The pre-employment and work maturity competencies have been specifically cross-referenced in this curriculum so that welding instructors could specify where these competencies are integrated into the curriculum.

Student leadership programs are designed to be an integral part of the curriculum. The competencies are reinforced by student participation in approved student organizations such as Vocational Industrial Clubs of America (VICA). The student leadership competencies have been cross-referenced in this handbook to assist the welding educator in identifying specifically where these competencies will be taught.

Vocational Industrial Clubs of America (VICA)

Vocational Industrial Clubs of America (VICA) is for students enrolled in secondary and postsecondary vocational courses in trade, industrial, technical and health education.

Through planned club activities, VICA develops the "whole" student, social and leadership abilities as well as vocational skills. The VICA motto is "Preparing for Leadership in the World of Work." VICA goals include:

- Foster an understanding of the functions of labor and management organizations and a recognition of their interdependence.
- Foster respect for the dignity of work.
- Relate school experiences to a young person's search for meaning, identity and achievement.
- Teach young people how to live and work with others...to accept and be accepted.
- Offer activities that complement occupational skill development.

- Create interest in and stimulate favorable community response to trade, industrial, technical and health occupations education.
- Promote high standards in work ethics, craftsmanship, scholarship and safety.
- Help students understand their roles in a technological age.

Alaska VICA, chartered in 1973, serves about 140 members in 10 chapters. The national organization is located in Leesburg, Virginia.

KEY	
H	Health
M	Math
S	Science
LA	Language Arts
SS	Social Studies
*	Pre-Employment Competencies
+	Student Leadership Competencies

Recommended Competencies by Course Offerings

	Competencies	Welding I	Welding II	Welding III	Welding IV		
	Welding Safety and Health						
•	Maintain a clean shop						
•	Use general safety procedures						
S •	Apply first aid skills						
S SS	Use tools safely						
M S	Follow electrical safety procedures						
S	Use safe welding procedures						
S LA SS	(A) Follow OSHA and AWS guidelines						
	Tools and Equipment						
S •	Use welding hand tools						
S	Use welding shop power tools						
M •	Utilize measurements and measuring devices						
	Blueprints and Layout/Specifications and Codes						
M LA	Use welding symbols and codes						
M LA	Understand welding blueprints						
M •	Apply basic math						
M	Use drawings						
	Welding Metallurgy						
M S	Understand properties of metals						
S	(A) Identify the metallurgy of a weld bead						
	Employability Skills						
LA • SS +	Make career choices						

Recommended Competencies by Course Offerings

	Competencies	Welding I	Welding II	Welding III	Welding IV		
LA * SS +	Evaluate jobs in the welding industry						
LA * +	Prepare a resume and job application						
LA * +	Write a cover letter						
LA * SS +	Interview for a job						
LA *	Follow up the interview						
* +	Dress appropriately on the job						
*	Manage personal responsibilities related to employment						
H *	Maintain good health for effective job performance						
SS * +	Understand employee rights and responsibilities						
LA * +	Attain work maturity						
LA * +	Make effective decisions						
* +	Demonstrate initiative and productivity						
* +	Be assertive						
* +	Be honest						
* +	Be reliable and dependable						
* +	Maintain good personal relations						
LA * +	Follow verbal and written directions						
LA * +	Apply communication skills						
LA * +	Deal effectively with customers						
LA +	Identify proper job resignation procedures						
LA +	Use leadership skills						
LA SS	Evaluate personal traits in relationship to entrepreneurship						

48

Recommended Competencies by Course Offerings

	Competencies	Welding I	Welding II	Welding III	Welding IV		
	Oxyacetylene Welding and Cutting (OAW and OFC-A)						
S	Oxyacetylene weld						
S	Oxyacetylene cut (OFC-A)						
	Shielded Metal Arc Welding (SMAW) & Air Carbon Arc Cutting (AAC)						
S	Identify principles of arc welding theory						
S	Apply shielded metal arc welding skills (SMAW)						
	Gas Metal and Flux Core Arc Welding (GMAW and FCAW)						
S	Apply gas metal arc welding skills (GMAW)						
S	Apply flux core arc welding skills (FCAW)						
	Gas Tungsten Arc Welding (GTAW)						
S	Apply gas tungsten arc welding skills (GTAW)						
	Special Welding Processes/Techniques						
S	Identify advanced welding techniques						
S	Plasma cut						
S	(A) Plasma arc weld						
S	(A) Submerged arc weld (SAW)						
S	(A) Resistance weld (RSW)						
S	(A) Weld pipe						
	Fabrication, Repair, and Rigging Skills						
M S	Apply metalworking techniques						
M S	Heat, form, and bend						
S	Use fabrication techniques						

Recommended Competencies by Course Offerings

	Competencies	Welding I	Welding II	Welding III	Welding IV		
M S	Complete a welding repair or fabrication project						
M S	Use rigging skills						

50

VI
Sample Skills Card

Sample Skills Card

This section of the guide provides teachers with an example of an instrument for evaluating the effectiveness of instruction. The skills record allows teachers to assess competency at four levels of proficiency. Teachers are encouraged to construct their own skills performance record using the competency lists in the curriculum section of this guide.

Instructions for Use

The list of vocational skills/traits was developed from a task analysis of a welding competency.

Level	Code Key
1	Introductory Level: Can do simple parts of task. Needs to be told/shown how to do most of the task. Needs extremely close supervision.
2	Minimum Level: Can do most parts of the task. Needs help only with most difficult parts. Needs close supervision.
3	Average Level: Can do all parts of task. Needs only spot-check of completed work. Meets local demands for speed and accuracy. Needs moderate job entry supervision.
4	Proficiency Level: Can complete task quickly and accurately. Can direct others in how to do the task. Needs little supervision.

Directions: The instructor/employer may write, date and initial in appropriate square.

Be reliable and dependable

1	2	3	4	
				Maintain acceptable attendance records
				Be on time
				Give timely notice of interruptions to work schedule
				Follow rules and regulations of work schedule
				Follow directions

Comments:

VII
Suggested Resources

Suggested Resources

This section identifies specific resources and sources for finding instructional materials and supplies for welding education.

The following source lists have been characterized by media type to facilitate teacher use: resource libraries, publishers, state resources, associations, periodicals, special books/pamphlets, media, equipment manufacturers. A tools list and suggested minimum tools and equipment needed for a welding program is also included.

The Department of Education has not formally reviewed nor approved all the resources listed in this section. Teachers are encouraged to preview materials before using them in the classroom.

Resource Libraries

Alaska Vocational Materials Library
Office of Adult & Vocational Education
Alaska State Department of Education
Box F
Juneau, AK 99811
(907) 465-2980

- Alaska Energy Education Series
- Appropriate Technology for Alaskans
- Basic Skills For The Trades
- Choices & Challenges: A Young Man's and Teen Woman's Journal for Self-Awareness and Personal Planning
- Construction Trades Curriculum and Resources
- Cooperative Education and On-The-Job Training Handbook
- Engine and Vehicle Mechanics Curriculum
- Home-Based Business Resources
- Industrial Education Curriculum
- Industrial Education Resources
- Local Advisory Committee: Handbook for Vocational Administrators
- Pre-Employment Competencies Resource Guide
- Safety and School Shop Planning
- STARS: Secondary Training For Alaska
- Vocational Education Administration Handbook

The Library maintains curricula for all vocational areas. Resources are loaned for a 2 month review period. There are also many materials which may be purchased from the Library's special collections. Some materials are available free of charge.

The Library's catalog is computerized and may be operated on an Apple Computer using Appleworks software. The catalog may be obtained by sending six blank disks for duplication or upon request.

Alaska Career Information System
Office of Adult and Vocational Education
Alaska Department of Education
Box F
Juneau, AK 99811
(907) 465-2980

- Comprehensive career guidance system developed by Alaskans and for Alaskans seeking occupational and educational opportunities in and out of Alaska.

Alaska Health Sciences Library
3211 Providence Drive
Anchorage, AK
(907) 786-1870

- Journals and magazines in the area of job safety and health

Alaska State Film Library
650 W International Airport Road
Anchorage, AK 99518
(907) 561-1132

- Films and videos on welding, oxyacetylene welding and cutting, and welding careers

Center on Education and Training for Employment
The Ohio State University
1960 Kenny Road
Columbus, OH 43210

- Vocational Education Curriculum Materials database of all 50 states. Can be accessed through the Alaska Vocational Materials Library.
- Catalog of materials available on new technology in vocational-technical education.

Curriculum Collection
Alaska Department of Education
Office of Educational Program Support
Box F
Juneau, AK 99811
(907)465-2841

- Village Science: A Resource Handbook for Rural Alaskan Teachers

Northwestern Vocational Curriculum Coordination Center
St. Martin's College
Lacey, WA 98503
(206)438-4456

- 10-state regional library of vocational materials. Can be accessed through the Alaska Vocational Materials Library.

Publishers

Bobbs-Merrill Co.
4300 W. 62nd. St.
Indianapolis, IN 46268

- Welding Technology

Claitor's Publishing Division
3165 S. Acadian at I 10
P.O. Box 3333
Baton Rouge, LA 70821

- Modern Methods of Pipe Fabrication
- Ordinates for 1000 Pipe Intersections
- Selected Piping Problems
- *Small lunch-pail sized booklets. Chock full of information. Inexpensive.*

Howard B. Cary
Prentice Hall
Englewood Cliffs, NJ 07632

- Modern Welding Technology

Delmar Publishers
2 Computer Drive West
Albany, NY 12212

- Mathematics for Plumbers and Pipe Fitters by Bartholomew D/Arcangelo, Benedict D'Arcangelo,and J. Russell Giest, © 1982
- Welding Procedures Electric Arc by Frank R. Schell, © 1977
- Welding Procedures MIG & TIG by Frank R. Schell & Bill Matlock, © 1978
- Welding Procedures Oxyacetylene by R. Schell, © 1977

Glencoe Publishing Company Bennett and McKnight 17337 Ventura Blvd Encino, CA 91316	• Essentials of Welding by Raymond J. Sacks • The Pipe Fitter's & Pipe Welder's Handbook • Pipe Template Layout
Goodheart-Wilcox 123 West Taft Drive South Holland, IL 60473 (312) 333-7200	• Modern Welding by Althouse, Turnquist Bowditch, and Bowditch • Oxyacetylene Welding: Basic Fundamentals
W.V. Graves Publisher PO Box 57924 Webster, TX 77598	• The Pipe Fitters Blue Book
Hobart School of Welding Technology Trade Square East Troy, OH 48373	• catalog of publications and videos • Programmed Audio visual training in Basic Shielded Metal-Arc Welding
Industrial Press Inc. 200 Madison Avenue New York, NY 10016	• Pipefitters Handbook, Third Edition Revised and Enlarged by Forrest R. Lindsey, © 1967
The James F. Lincoln Arc Welding Foundation Toronto, Ontario, Canada M5C-2A5 or Cleveland, OH 44117	• Arc Welding by William Sellon and John Mathews, 1979 • Metals and How to Weld Them by T. B. Jefferson, © 1962 • Welding Instructions for the Beginner by H.A. Sosnin, © 1964
Lincoln Electric Company 22801 St. Clair Ave. Cleveland, OH 44117-1199	• The Procedure Handbook of Arc Welding, © 1973 • Newsletter
McGraw Hill Book Co. Western Regional Office 8171 Redwood Highway Novato, CA 94947	• Handbook of Stainless Steels by D. Peckner & I. Bernstein • Welding Skills and Technology by Dave Smith, © 1984
Penton Publishing 1100 Superior Ave. Cleveland, OH 44114	• Welding & Fabricating Data Book
Ryerson Steel Box 3525 Seattle, WA 98124	• Steel and Aluminum Data Book
Smith Welding Equipment Division of Tescom Corporation 2601 Lockheed Ave. Watertown, SD 57201	• Complete course outlines for oxyacetylene welding. *Excellent resource.*
Synteks Books Co. PO Box 26588 San Francisco, CA 94126	• The Piping Guide

Tube Turns
2900 W. Broadway
Louisville, KY 40211

- Welding Fittings and Flanges

Universal Welding Supply Co.
Cedar & Oak Streets
New Lenox, IL 60451

- Universal Pipe Fitters' Layout Guide

State Publications

Curriculum Center
Sangamon State University
Springfield, IL 62794-9243
(217)786-6375

- How to Become a Certified Welder

Curriculum and Instructional Materials Center (CIMC)
Oklahoma State Department of Vocational and Technical Education
1500 West Seventh
Stillwater, OK 74074-4364
1-800-654-4502

- VICA Leadership Handbook
- VICA: Learn, Grow, Become

Curriculum Materials Service
Department of Vocational Education
Colorado State University
Fort Collins, CO 80523

- Occupational Analysis: Combination Welding Entry-Level

Curriculum Publications Clearinghouse
Illinois University
Horrabin Hall Y6
Macomb, IL 61455
(309)298-1917

- Vocational-Technical Education Western Consortium of States (V-TECS) catalogs of performance objectives and curriculum guides for welding

District of Columbia Public Schools
Division of Career Development Programs
Presidential Building
415 12th Street NW
Washington, DC
(202)724-4178

- Welding Scope and Sequence

Educational Instructional Materials Center (EIMC)
Division of Continuing Education
University of Texas at Austin
PO Box 7218
Austin, TX 78713-7218
(512)471-7716

- Sheetmetal Worker Competency Profile
- Welding Fundamentals

Florida Department of Adult and Vocational Education
College of Education
University of South Florida
Tampa, FL 33620

- Program Guide to Basic Welding, Welding, and Welding Technology
- Student Performance Standards for Basic Welding

Instructional Materials
Industrial Education
202-B Skyland Blvd.
Tuscaloosa, AL 35405
(205)759-5448

- Curriculum Standards for Welding
- Welding Combination Cluster

Instructional Materials Laboratory Ohio State University 842 W. Goodale Blvd. Columbus, OH 43212	• Welding Lab Management Guide
Instructional Materials Laboratory University of Missouri-Columbia 10 Industrial Education Building Columbia, MO 65211 (314)882-2883	• Vocational Preparation Curriculum: Welding • Welding Competency Profiles
Instructional Materials Service Texas A&M University FE Box 2588 College Station, TX 77843-2588 (409)845-6601	• Oxyacetylene Welding Transparencies • Welding Course Outlines
Lake Oswego Public Schools Curriculum Department 2445 SW Country Club Road Lake Oswego, OR 97034 (503)635-0302	• Introduction to On-Site Construction Oxyacetylene Burning and Arc Welding for the Building Construction Program
Maryland Vocational Curriculum Research and Development Center University of Maryland JM Patterson Building College Park, MD 20742 (301)454-2260	• Welding Instructional Guide
Minnesota Curriculum Services Center 3554 White Bear Avenue White Bear Lake, MN 55110 (612)770-3943	• Welding Occupational Task List • Welding Occupational Terminal Performance Objectives
Oregon Department of Education 700 Pringle Parkway SE Salem, OR 97310	• Individualized Learning Systems: Welding
South Carolina Department of Education Office of Vocational Education Vocational Curriculum Development Section Columbia, SC 29201	• Welding Curriculum
Vocational Curriculum Development and Research Center PO Box 1159 Natchitoches, LA 71458-1159 (318)352-5348	• Competency-Based Postsecondary Welding Curriculum Guide
Utah State Office for Vocational Education 250 East 500 South Salt Lake City, UT 84111	• Metal Fabrication III and IV, Integrated Shop Program

Washington State Commission for Vocational Education
Airdustrial Park, Building 17
Olympia, WA 98504
(206)753-5675

- Vocational Education Student Learning Objectives for Welding

Yukon Flats School District
Box 359
Ft. Yukon, AK 99740
(907)662-2515

- Welding Curriculum Guide

Associations

Aluminum Association
900 19th Street NW
Washington, DC 20006
(202)862-5100

- Aluminum Standards and Data
- catalog of publications
- Library on aluminum technology and aluminum industry.

American Association for Vocational Instructional Materials (AAVIM)
Driftmeir Engineering Center
Athens, GA 30602

- Arc Welding

American Iron and Steel Institute
1133 15th Street NW
Washington, DC 20036
(202)452-7100

- Conducts research programs for areas such as manufacturing technology, basic materials
- publishes technical manuals and general pamphlets

American National Standards Institute
1430 Broadway
New York, NY 10018
(212)354-3300

- catalog of standards

American Petroleum Institute (API)
1220 L St. NW
Washington, DC 20005
(202)457-7000

- API 1104; Standards for Welding Pipe Line

American Society for Metals
Route 87
Metals Park, OH 44073
(216)338-5151

- Metals Handbook; Volumes 1,2,3,6 & 11

American Society of Mechanical Engineers (ASME)
345 E. 47th St.
New York, NY 10017
(212)644-7722

- ASME Section 9; Welding & Brazing Qualifications

American Welding Institute
10628 Dutchtown Road
Knoxville, TN 37932
(615)675-2150

- forum for new welding and joining techniques
- welding information database, newsletter

American Welding Society (AWS) 550 N.W. LeJeune Road PO Box 351040 Miami, FL 33135 (305)443-9353	• Consider a Career in Welding • Resistance & Solid State Welding & other Joining Processes • Safety in Welding and Cutting • Student Chapter Manual for Organization and Operation • Welding Handbook, Vol. 1 • Welding Technology, Vol. 3
Construction Safety Association of Ontario 74 Victoria St. Toronto, ON M5C 2A5 (416)366-1501	• Rigging Manual
Edison Welding Institute 1100 Kennear Road Columbus, OH 43212 (614)486-9400	• Maintains library, database access, publishes Edison Insights in Welding Journal, research reports, conducts research
Mid-America Vocational Curriculum Consortium (MAVCC) 1500 West Seventh Avenue Stillwater, OK 74074-4364	• Blueprint Reading and Layout for Welding • Gas Metal Arc Welding/Flux-Cored Arc Welding • Gas Tungsten Arc Welding • Introduction to Welding • Oxyacetylene Welding and Cutting • Pipe Welding • Sheet Metal Series • Shielded Metal-Arc Welding • Welding Series Transparency Set
National Safety Council 444 North Michigan Ave. Chicago, IL 60611 (312) 527-4800	• Accident Prevention Program for School Shops • Safe Worker
National Welding Supply Association 1900 Arch Street Philadelphia, PA 19103 (215)564-3484	• Manufacturers and distributors of welding equipment and supplies
Society of Manufacturing Engineers One SME Drive PO Box 930 Dearborn, MI 48128 (313)271-1500	• High technology materials
Vocational Industrial Clubs of America (VICA) PO Box 3000 Leesburg, VA 22075	• Advisor Guide • National Leadership Handbook
Welding Research Council 345 E.47th Street New York, NY 10017	• Conducts research in welding, and closely allied fields • Publishes books, monographs, biblio's, literature reviews, reports • Research bulletins, progress reports • Welding Research Abroad

60

Periodicals

American Industrial Arts Association
1914 Association Drive
Reston, VA 22091
- The Technology Teacher

American Society for Metals
Materials Information
Metals Park, OH 44073
(216)338-5151
- Welding/Brazing/Soldering Digest

American Vocational Association
1410 King Street
Alexandria, VA 22314
- Vocational Education Journal

American Welding Institute
New Topside Road
Rural Route 4, box 90
Louisville, TN 37777
(615)970-2150
- Welding Information Newsletter

American Welding Society
550 LeJeune Road NW
PO Box 351040
Miami, FL 33135
(305)443-9353
- Welding Journal

Cummins Publishing Company
31600 Telegraph Road, Suite 200
Birmingham, MI 48010
- Industrial Education

Prakken Publications
PO Box 8623
Ann Arbor, MI 48107
- School Shop

Welding Research Council
345 East 47th Street
New York, NY 10017
(212)705-7956
- Welding Research Council- Research Bulletins
- Welding Research News

Special Books/Pamphlets

Alloy Rods Corp.
PO Box 517
Hanover, PA 17331
- write for manual

National Institute for Occupational Safety and Health
Regional Office
321 Second Ave.
Seattle, WA
(206) 442-0530
- Research and technical assistance, information and publications for all areas of job safety and health

L-TEC Cutting Systems
Union Carbide Corporation
Linde Division
270 Park Ave.
NY, NY 10017
- MIG Welding Handbook
- The Oxyacetylene Handbook
- Submerged Arc Handbook

Media: Health and Safety Materials

Bergwall Productions, Inc.
PO Box 238
Garden City, NY 11530-0238
1-800-645-1737

- Welding Technologies video series

Coastal Video Communications
Virginia Beach, VA
(804)498-9014

- Welding Safety "Securing the Work Zone"

The Film Library
3450 Willshire Blvd. Suite 700
Los Angeles, CA 90010

- catalog of materials

Industrial Training Systems Corp.
20 W. Stow Rd.
Marlton, NJ 08053

- Welding Health Hazards & Welding Physical Hazards

National Audio Visual Center
8700 Edgeworth Dr.
Capitol Heights MD 20743-3701

- Hazards of Gas Welding

Tel - A - Train
3461 Brainard Rd.
Suite 201
Chattanooga TN 37411

- Oxyacetylene Safety

Equipment Manufacturers

Many of these manufacturers have how to booklets and instructional materials. Write for details.

Airco Welding Products
4437 E. 149th St.
Cleveland, OH 44125

Hobart Equipment Company
600 West Main St.
Troy Ohio 45373

Lincoln Electric Manufacturing
22801 St. Clair Ave.
Cleveland, OH 44117-1199

Miller Electric Manufacturing Company
P.O. Box 2222
Appleton, WI 54913

PowCon
Cyclomatics
8123 Miralani Dr.
San Diego, CA 92126
FAX 619-578-8575

Smith Equipment
Division of Tescom Corp.
2601 Lockheed Ave.
Watertown, SD 57201

Victor Equipment Company
P.O. Box 1007
Denton, TX 76202-1007

B2

Tools List

It is recommended that the following tools be available for each student:

Brush
Chisel
*Earplugs
Tip cleaner
Center punch
*Safety glasses
Chipping Hammer
Ball peen hammer
Needle-nose pliers
Combination square
Scriber with magnet
Diagonal wirecutter
8" vice-grip pliers
8" slip-joint pliers
Oxyfuel torch-striker
*Leather sleeves with an apron
*Oxyfuel cutting welding goggles (#5 lens)
*Welding helmet with chipping lens and #10 filter lens
*Welding gloves

*Mandatory items for each student.

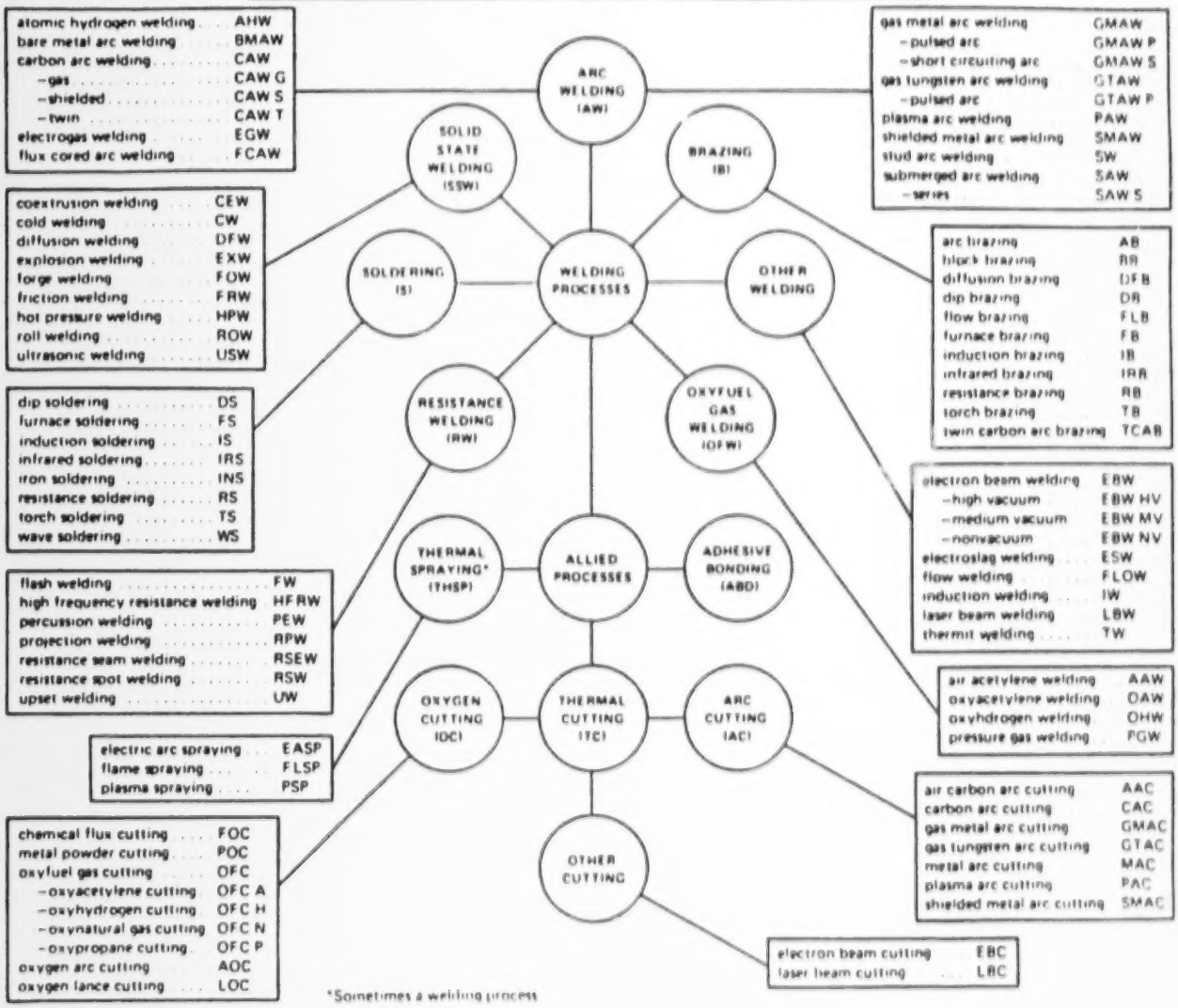
Suggested Minimum Tools and Equipment for A Welding Program

Recommend one student per welding station. Quantities of equipment should be sufficient for the number of students in the class.

- oxyfuel workstations
- industrial-quality Shielded Metal Arc Welding (SMAW) power sources (The lab should have at least one power source adequate for heavy-duty work and arc-air cutting.)
- AC/DC high frequency, Gas Tungsten Arc Welding (GTAW) power sources.
- Gas Metal Arc Welding (GMAW)/Flux Core Arc Welding (FCAW) power sources and wire feeders.
- Gas Metal Arc Welding (GMAW) power source and wire feeder
- power shears
- iron worker
- power roll (optional)
- pedestal grinders (12" X 1 1/4" arbor)
- bench grinders (6" X 5/8" arbor)
- drill press (multispeed, geared-head)
- plasma-arc cutting (PAC) unit
- air carbon-arc
- bend test fixture
- hand grinders
- abrasive cut-off saw
- portable, engine-driven power source (optional)
- panograph (optional)
- press brake (optional)

- monorail or overhead crane (minimum capacity: one ton) (optional)
- belt sander (6") (optional)
- horizontal band saw (optional)
- vertical band saw (optional)
- hydraulic arbor press (optional)
- welding positioner (optional)
- submerged-arc welding unit (optional)
- resistance spot-welder (optional)

MASTER CHART OF WELDING AND ALLIED PROCESSES



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